

I, Wilfried Adam, declare:

1. That I am a citizen of Germany and a translator to Jürgen Leineweber, Dipl.-Phys., Aggerstr. 24, D-50859 Köln, Germany.
2. That I am well acquainted with the German and English languages.
3. That the attached is a true translation into the English language of the accompanying document P02.05wo.

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**Method for Producing the Rotor of a Drag Vacuum Pump and a Rotor Produced
According to this Method**

The invention relates to a method for producing the rotor of a drag vacuum pump according to the characteristics of patent claim 1. Moreover, the invention relates to a rotor produced according to this method.

It is known to produce the individual blades of a rotor of a turbomolecular vacuum pump in that the outer surface of a cylindrical blank (preferably of aluminium) is provided with radial peripheral grooves and axially oriented grooves, such that blades are created in planes perpendicular with respect to the axis of rotation. In order to attain blades exhibiting an effective pumping action, each of the multitude of blades needs to be subsequently set. Generally the blades shall have differing angles of attack/setting angles depending on their distance with respect to the inlet. The known production method does not allow for further variations of the blade profiles.

Moreover, it is known to prepare the blades by milling these from the surface of a blank, such that subsequent setting will no longer be required. This manufacturing procedure involves long processing times, particularly since it is desirable that the blades of different blade rows exhibit differing blade profiles and/or angles of attack.

It is the task of the present invention to reduce the previously required processing times and thus the costs for manufacturing rotors for drag vacuum pumps.

In accordance with the invention this task is solved through the characterising features of the patent claims. The invention allows the formation of rows of blades exhibiting differing angles of attack or blade profiles in a simple manner through metal cutting operations. This can be achieved in that the pitch of the thread grooves is varied in accordance with the desired conditions. By applying the methods according to the invention the milling times may, in addition, be reduced to a minimum, respectively milling can be replaced completely by turning operations.

Further advantages and details of the present invention shall be explained with reference to the examples of embodiments depicted in the drawing figures and 1 to 9¹⁾.

Depicted are in

- drawing figures 1 to 4 much schematised rotors, manufactured in accordance with the present invention, whereby the rotors in accordance with the drawing figures 1 and 2 are depicted in their semi-finished state,

¹⁾ **Translator's note:** The German text states "8" here whereas "9" would be more in line with the drawing figures. Therefore the latter has been assumed for the translation.

- drawing figures 5 to 7 rotors with greater detail, manufactured in accordance with the present invention, whereby the rotor in accordance with drawing figure 5 is depicted in its semi-finished state, as well as
- drawing figures 8 and 9 partial sections through drag vacuum pumps with rotors manufactured in accordance with the present invention.

In all drawing figures the rotor is in each instance designated with 1 and its hub with 2. In the instance of completed rotors at least a section of the hub 2 supports rows of blades 4 separated by peripheral grooves 3, whereby the individual blades are in each instance designated as 5. In the assembled state (drawing figures 8 and 9)²⁾ the rows of stator blades 9 engage in the peripheral grooves 3. The rotation of the rotor 1 effects the desired pumping of gases from the suction side 11 to the delivery side 12 of the rotor 1.

Drawing figures 1 to 3 depict the manner in which a rotor 1 can be manufactured according to the present invention. Initially a, for example, cylindrical blank is provided either with thread grooves 13 (drawing figure 1) or with radial peripheral grooves 3 (drawing figure 2). After this step there is created in each instance the hub 2 of the rotors 1. The hub 2 according to drawing figure 1 carries one or several thread ridges 14, the hub 2 according to drawing figure 2 carries peripheral radial ridges 15.

²⁾ **Translator's note:** The German text states "(drawing figures 7 and 8)" here whereas "(drawing figures 8 and 9)" would be more in line with the drawing figures. Therefore the latter has been assumed for the translation.

Thereafter the rotor 1 according to drawing figure 1 is provided with the peripheral grooves 3, and the rotor 1 according to drawing figure 2 is provided with thread grooves 13. Thus in the instance of both methods the rotor 1 according to drawing figure 3 is created. On the hub 2 there remain blade rows 4 separated by the peripheral grooves 3. The profiles (width, length, cross-section) and the angles of attack of the blades 5 of a row of blades 4 depend on the width and the depth of the adjacent grooves 3, 13 as well as on the pitch of the thread grooves 13 at the level of the respective row of blades 4.

Drawing figure 4 depicts a rotor 1 which exhibits along its entire height thread grooves/ridges 13, 14. Only at its upper section are radial peripheral grooves 3 provided in addition. Through these measures, a one-piece rotor 1 for a drag vacuum pump is created, which is designed section-wise (on the intake side) as a turbomolecular pump and (on the delivery side) as a molecular pump (Holweck pump). From drawing 4 it is finally apparent that the pitch and above all the changes in pitch for the thread ridges 14 can be selected freely so that the pumping properties may be adapted precisely to the pressures prevailing at each point of the pumping channel.

Drawing figures 5, 6 and 7 depict a rotor 1 in which the thread ridges 14 exhibit a constant pitch across the entire height of said rotor. Drawing figure 5 depicts the rotor 1 in its semi-finished state; it exhibits only thread ridges 14, respectively thread grooves 13. Drawing figures 6 and 7 depict various views (drawing figure 6 side view, drawing figure 7 a view at an angle from below) of the finished rotor 1. After

manufacturing of the thread grooves 13, the radial peripheral grooves 3 have been manufactured by turning.

Drawing figure 8 depicts a sectional view through the active pumping area of a turbomolecular pump 21. Stator blades 9 engage in the radial peripheral grooves 3 of the rotor 1 manufactured in accordance with the present invention. A cylindrical stator 22 with stator rings and blade rings serves, in a known manner, the purpose of supporting the stator blades 9. The depth of the peripheral grooves 3 decreases from the intake side 11 towards the delivery side 12. The same applies correspondingly for the length of the effective pumping blades of the row of blades 9. The result is a pumping cross section which decreases from the intake side towards the delivery side. The method in accordance with the present invention allows to manufacture, in a simple manner, a rotor 1 with the pumping properties described or also with other pumping properties.

In the embodiment according to drawing figure 9, only the intake section of the pump 21 is designed by way of a turbomolecular pump. The section on the delivery side is equipped with thread grooves/ridges 13, 14 with their width/height reducing towards the delivery side. Jointly with the inner surface of the stator 22 said section on the delivery side forms a Holweck pump. Also indicated is a third pumping stage 23, located downstream of the Holweck pumping stage of the rotor 1. Said third pumping stage comprises a thread 24 sunk into the stator 22, whereby said third pumping stage forms a further Holweck stage with the cylinder 25 affixed to the rotor 1.